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ELLIPTIC FOURIER ANALYSIS OF OTOLITHS OF TRIGLIDAE IN THE NORTH-MIDDLE ADRIATIC SEA

ANALISI ELLITTICA DI FOURIER DEGLI OTOLITI DEI TRIGLIDI IN ALTO-MEDIO ADRIATICO

Abstract - The sagittal otoliths of specimens belonging to seven species of triglids collected in the north-middle Adriatic Sea were investigated by means of the Elliptic Fourier Analysis method (EFA). The EFA method was proved to be a suitable tool for the separation of species showing intra-interspecific differences. Thus, it could provide useful information in phylogenetic and eco-morphological studies.

Key-words: otolith, shape analysis, Elliptic Fourier Analysis, Triglidae, Adriatic Sea.

Introduction - Fish otolith shape analysis is an important way for describing and characterizing mathematic otolith outlines. It is used with multiple goals, for example, species phylogeny and stock discrimination (Lombarte et al., 2006). In particular the Elliptic Fourier Analysis (EFA) represents one among the most valuable and time-efficient method since data are automatically normalised in relation to the first harmonic and consequently they become invariant to size, rotation, and starting point (Iwata and Ukai, 2002). In this study the EFA method was applied on otoliths collected from 7 species of triglids (Aspitrigla cuculus, Chelidonichthys lastoviza, C. lucerna, Eutrigla gurnardus, Lepidotrigla cavillone, L. dieuzeidei and Trigla lyra) (Teleostei, Scorpaeniformes) distributed in the north-middle Adriatic Sea. The aim of this study is to verify the existence of intra and interspecific differences associated with endogenous and exogenous factors.

Materials and methods - A total of 240 specimens were selected from samples collected during bottom trawl surveys carried out in 2007 and 2008 along the Italian coasts from the Gulf of Trieste to the Tremiti Islands. For each specimen total length (TL, mm), weight (W, g) and sex were recorded. The left sagitta was removed, cleaned in ultrasounds bath and kept dry for later analysis. For each species otoliths selected from adult (males and females) individuals and from juvenile (undetermined) ones were analyzed. Digital images were collected using a NIKON P5100 digital camera linked to a Leica MZ6 stereomicroscope. Each sagitta was photographed with the sulcus acusticus facing up and the rostrum to the right. The SHAPE program was used to extract the contour shape of the sagitta and to assess the variability of shapes by means of the study of principal component analysis (PCA). The statistical analysis of the collected data was carried out by means of the R software (R Development Core Team, 2010).

Results - About 99% of variation in otolith shape was explained by a maximum of 20 harmonics. The first 4 discriminated over 80% of the variance. In most samples, the first component discriminated better the different widths of otoliths; the second was better related to different shape of excisura ostii; the third and fourth were better related to different shape of rostrum and antirostrum. The interspecific comparison of adult specimens showed the Genus Lepidotrigla and C. lastoviza phylogenetically close, while L. dieuzeidei was discriminated by the Genera Aspitrigla and Eutrigla.
The interspecific variability of juvenile specimens showed that *C. lucerna* and *T. lyra* were widely discriminated. This finding is probably due to individual genetic factors (Gauldie and Crampton, 2002) and to the different depths of their trophic niches. In fact, during their life cycle, triglids in Adriatic show a differential migration pattern to greater depths and away from the Italian to the Croatian coast (Montanini et al., 2008). The intraspecific variability of adult specimens was higher for *C. lucerna* and *E. gurnardus* while it was lower for the Genera *Aspitrigla* and *Lepidotrigla*. Intraspecific comparison between juveniles and adults showed that in all species there was an increase in otolith shape variability linked to growth and to environmental conditions.

**Conclusions** - According to these results, the EFA method was proved to be a suitable tool for supporting phylogenetic and eco-morphological investigations and assessing affinities among the investigated triglids species. It allowed to find similarity between *Lepidotrigla* sp. and *C. lastoviza*; distance between *C. lucerna* and *T. lyra* and an increase in the variability of otolith shape from juveniles to adults. However, in order to facilitate correct biological interpretation of data, the EFA method should be correlated with appropriate sampling plans (Farias et al., 2009; Stagioni et al., 2009).

**References**


